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The Integrative Technology Initiative (ITI) at the Dyslexia Association of Singapore (DAS)

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Abstract

Current perspectives on specialist education encourage a seamless integration of technology into the design and delivery of a programme. The Dyslexia Association of Singapore (DAS) conducted a trial study of the Integrative Technology Initiative (ITI) with thirty-seven educators and ninety-one students. The pre-trial study, comprising a survey and dialogue session, revealed that a successful integration of technology hinged heavily on the positive mindset shift of the educators. Consequently, phase one of the ITI trial evaluated the appropriateness of the use of iPads as an administrative tool to reframe educators' views on ITI. With an achieved receptivity, the ITI trial entered the second phase where suitable iPad applications, which may effectively assist students to learn and cater to the differing needs of individuals within a group without compromising the quality or quantity of learning outcomes were utilised in instruction. Phase two of the ITI trial therefore evaluated the effectiveness of the use of iPads in a classroom through the feedback from students and educators. This paper explores results from the ITI trial and discusses the implications and future initiatives to be undertaken so that DAS can truly enable students to achieve their potential. While the usual variables for acceptance of technology such as perceived usefulness and perceived ease of use are found to be important in the implementation of new technology initiatives, our findings show that other factors, such as the issue of device ownership, are equally important factors in the successful implementation.

Keywords: iPad, Dyslexia Intervention, Technology adoption, Dyslexia, Technology acceptance model, Technology integration, Technology-readiness

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Reading is not an ability from birth (Wolf, 2008), and yet, the very ability to read is a major success-determining skill to lead a functional life in the modern society. Children with dyslexia and other learning disabilities often struggle to learn to read due to the differences in brain neurology or function (Shaywitz, 2005). Prolific author and dyslexia advocate Thomas West wrote about his own struggles with dyslexia:

> *In my own story, the beginning is familiar. The story of a little boy who could hardly read at all for the first three or four years of primary school – and then struggled for many years to keep up with his classmates. For a long time, his greatest ambition was to not be at the bottom of the class. (Hewes, 2015, p. xxiii)*

While there is a definite urgency to empower such learners, it's critical that educators and educational organisations fully evaluate the effectiveness of the intervention they plan and implement. The "Dyslexia and Literacy Difficulties: Policy and Practice Review", acknowledges that there are many "alternative treatments and 'miracle cures'" (2013, p.16) and warns that many of these intervention practices and programmes are not evidence based, preying instead on the uncertainty surrounding the definition of and conversation regarding dyslexia.

Consequently, the compelling advice is to base decisions on data presented through unbiased research. In this uncertain but highly innovative climate, where there is no common consensus on what works, such evidence based practice informs practitioners and decision makers on approaches that may yield best results for their learners. DAS is truly behind the call for evidence in determining practice and so, conducts regular research and intervention studies to ensure that the programmes and instructions remain current and beneficial to the learners it supports, while highlighting areas needing enhancements.

In the same vein, prior to the implementation of initiatives, DAS carries out trial studies to fully appreciate the gains to learners. One such study was the Integrated Technology Initiative (ITI), the onset of which was in 2014, where one of the objectives was to trial the use of mobile technology in teaching and learning. In today's fast paced and well connected world, technology's ubiquity means it's accessible to most, and has set its place firmly in all aspects of one's life. As such, educational technology naturally finds itself a point of reference in specialist instruction as we search for solutions.

However there are also limitations, and the effectiveness of technology use, particularly in instruction, relies heavily on the people who administer it, rather than devices themselves being seen as valuable educational tools. In other words, technology is at its best when it is "supported with the effective instruction and... by a knowledgeable and caring professional." (Bray, Brown & Green, 2004, p.2) Therefore, this paper aims to shed light on the benefits of technology use in special education, the ensuing debate on user perceptions and the way forward for implementation of technology initiatives through an evaluation of ITI.

Benefits of technology use in the classroom

> *Differentially instruct me, I'll internalise. Use technology with me, I'll participate, I'll transfer, I'll employ and I'll create. (Erben, Ban & Castañeda, 2009, p.65)*

While a pendulum balance swings in the debate between the advantages and disadvantages of technology use in the classroom, proponents claim many benefits and not least of which is its ability to level the playing field for learners with learning difficulties. Bray, Brown and Green (2004) extend this notion further by suggesting that difficulties can be transformed into strengths when the right presentation is chosen for both teaching and demonstration of learning.

Additionally, one of the principles of the Orton-Gillingham approach, that is delineated to enable practitioners to better support learners with dyslexia, required instructions to be simultaneously multisensory, a technique also referred to as the "language triangle" (Gillingham & Stillman, 1997, p.30). Since then, there have been countless research papers and studies expounding the benefits of well-executed multisensory activities, which reveal that children with learning difficulties learn best through multisensory activities (Logsdon, 2014). By virtue of its very nature, technology lends itself effortlessly to multisensory teaching and learning.

Another vital benefit of technology use includes workforce readiness. Through the introduction of technology in the classrooms, we are able to prepare our students for success as they approach tertiary education and the workforce (Bray, Brown & Green, 2004).

Yet, above and beyond the benefits to learners, it was found that the receptiveness of teachers in accepting and effectively assimilating technology into instruction was critical for its success in enhancing student learning. Teachers, and not technology, are the agents of change. Not surprisingly, Ertmer and Ottenbreit-Leftwich (2010) suggest that some level of change in terms of beliefs, attitudes, knowledge, practice and resource utilisation and development is necessary when they begin to use technology.

ITI was therefore designed to facilitate these changes. With the current perspectives on specialist education, which encourage seamless integration of technology into the design and delivery of a programme, DAS has taken a unique approach to facilitate this change by including educators, and just students, as the main beneficiaries of ITI.

By implementing the use of mobile technology, namely the iPad, as an administrative tool for teachers before using it as learning and teaching tool, ITI expected to encourage change in teacher perspectives to enable more successful implementation of technology in teaching and learning. Hence, this explorative study directly explored and analysed the impact of teachers' perception on the effective implementation of technology in the classrooms of DAS as a means to comment on successful technology integration in specialist education.

iPads as the tool of technology integration

A system consisting of students, educators, pedagogical practices, values and technology may be referred to as classroom information ecology (Nardi, 1999). As a first step, the interest of the study was to evaluate the appropriateness of the use of iPads as an administrative tool and thus reframe educators' views on ITI, documenting any effect on this 'ecology' throughout the study. Unlike more traditional "desktop technologies", mobile technology - in this case, the iPad, may be more easily integrated into the daily life of teachers and students.* It also has the potential to redefine what represents a learning space, as it may facilitate more robustly situated learning practices such as collaborative learning. Numerous researchers and educators around the world are aware of this potential and there are many studies being conducted worldwide, testing hypotheses similar to this; see (Hu, 2011), (Chen, 2010), (Wilson 2011) or (White, 2010).

In addition, iPads are generally perceived as devices that have an intuitive and easy to use interface. The influence of perceived usefulness and ease of use are discussed in relation to acceptance of technology (Davis, 1989). Additionally, further variables have been relevant to the technology acceptance model (TAM) originally proposed by Davis in 1986. TAM is perceived as an influential extension of the theory of reasoned action (TRA), according to Ajzen and Fishbein (1980). Benbasat and Barki listed trust, cognitive absorption, self-efficacy, job relevance, result demonstrability, information satisfaction, top management commitment, personal innovativeness, information quality, computer anxiety, and perceptions of external and extrinsic controls as some of the factors that may be important for the acceptance of technology (Benbasat & Barki 2007). These were therefore carefully considered with available resources in order for ITI to be primed for success.

Pre-study selection of iPad Apps

Before the commencement of the ITI trial, a selection process was also initiated to identify suitable iPad applications which may effectively assist teachers and students to cater to the differing needs of individuals within a group without compromising the quality or quantity of learning outcomes. Generally, mobile device applications (apps) may not be able to provide the range of facilities found within any fully functioning software used on a computer or laptop. However, some users have reported on being able to gain sufficient support to maintain a mobile working environment by using a few carefully selected apps and with specific features enabled on the device itself (Chinnery, 2006).

Furthermore, apps vary in design as well as in the support tools and options they offer, but this is not always reflected in the price they command. Cost alone is not an indicator of quality or usefulness. There are some great apps which offer a range of significantly useful features for what is a relatively small price.

Since the complexity of learning to read and spell is indisputable, there are numerous programs, both on computers

and hand-held devices that have been developed to teach reading, reading-readiness and other learning related skills. Yet, only a few of these programs have been empirically validated. As mentioned in some of the articles and studies, there is no easy way to determine the quality of an iPad application. In her studies, Schuler encourages the collaboration of those in the app-making industry, policymakers and educators to "create standards for apps marketed as educational" (Schuler 2009). In this study, it was found that the "trial and error" method worked for the evaluation of the effectiveness of the apps as the learning attitudes and needs of dyslexic learners vary widely in terms of interests and abilities. Fortunately, due largely to the robust competition among app developers, there are many free or "lite" versions of apps that give end users the opportunity to try it out first before purchasing.

Also, some reputable organisations provide recommendations, such as Reading Rockets *(www.readingrockets.org),* which publishes lists of top spelling and comprehension apps, and the Texas Computer Education Association, which lists "free and must-have apps" *(www.tcea.org).* The British Dyslexia Association (BDA) too has a list of recommended apps for dyslexic learners, their parents and educators (Dobbs, 2014). Although it must be noted that these recommendations are only for guidance, the apps chosen were sieved through ethnographic factors, especially for students from English as second language (ESL) background. Table 1 lists the apps that have been preloaded into the iPad devices after this selection process with the DAS.

Yet despite all efforts to identify suitable apps, learners and teachers will ultimately need to embrace the way technology could potentially alter the pedagogy, considering questions such as how lesson planning and assessments might be changed along with the users' confidence and competence in the use of technology. Smythe (2012) emphasizes how applications may be introduced and how levels of support during the initial period may play a crucial role in the overall mastery of the app:

"No individual is going to learn all the functionalities in one training session. It is better to have a brief introduction and slowly introduce additional functionality as and when the others are mastered." (Smythe, 2012, p161).

Despite enthusiasm for the use of apps in these contexts (McKeown & McGlashan, 2014) and the fact that educational institutions commit considerable funds to adopting Information and Communication Technology (ICT), there is a need for evidence to support the selection of apps. Currently, research into identifying most effective apps for vulnerable learners and the facilities and strategies required to facilitate their adoption remains limited. This is potentially an area of further investigation for DAS.

Phase one of ITI

The ITI trial was conducted in two phases. The aim of phase one was to evaluate the appropriateness of the use of iPads as an administrative tool and in ensuring the appropriateness, reframe educators'

Table 1: Apps preloaded into DAS iPads

Skill	**Application**
Phonemic Awareness	OG card deck - phonics cards ABC Spelling Magic (1, 2 and 3) - movable letters 
Fluency	Why-Who – Reading and card matching game Flashcards – by dictionary.com Sight Words Matching – reading and card matching game 
Vocabulary and spelling	Word Bingo – spelling practice Electric Company – vocab words to describe emotions Nessy - Dyslexia Quest 
Handwriting and written	English Cursive Handwriting Practice, Pages, Glow colouring and drawing, Educreations, iBooks, Notes 
Story-telling and comprehension	Puppet Pals - story telling app, iBrainstorm, Skitch, Toontastic - story telling app 
*For educators	Class Dojo, Socrative, Textgrabber, Keynotei, Reward Chart, Dropbox / Google Drive, Gmail 

views on education technology. Thirty-eight educators with varied experience levels and ninety-one students participated in ITI, which had been divided into two phases of implementation. Of the thirty-eight, there were two male and thirty-six female educators, with a very wide age and experience range. Each educator was equipped with an iPad preloaded with a list of applications (refer to Table 1). The iPads also came with origami covers, which allowed multi-positional viewing. Educators were to choose a class with which the iPad applications' effectiveness was explored as an administrative as well as a teaching and learning tool. At DAS, students have sessions with educators in a class size of up to four at a time with a duration of either one or two hour blocks. These small sized classes happen in rooms with constant Wi-Fi connectivity.

Further, administration-oriented tasks were also suggested. These included taking minutes during meetings, marking of student attendance, maintenance of reward system, classroom management, assessments (quizzes and reviews) as well as parent-teacher communication. The apps specifically utilised were Textgrabber, Class Dojo, Socrative (Teacher and Student), iRewardChart, Notes, Pages, Google Drive, iBooks and Keynote. This was on top of the already in -use apps such as Chrome, Google Mail, Microsoft (Word, PowerPoint, Excel) and Calculator.

The main method of retrieving data was through polls and internet questionnaires, where perspectives, practices and motivation from both teachers and students, were fundamentals to the analysis of technology adoption process. The analysis pointed towards device ownership (one device per user) and cooperation (opportunities for collaboration) as interesting variables to consider in relation to mobile technology adoption for education in DAS.

Phase one Results

After a period of 10 weeks, educators were given an online survey form to share their views. For instance, when asked what the iPads were used for, 97% selected administrative, 100% selected instructional and 30% selected entertainment purposes (see Figure 2). It was encouraging that educators were highly motivated to utilise the devices for classroom-related purposes.

Not surprisingly, several questions were on educators' perception of the device and the teachers' views were heartening (see Figure 3). All the participating educators agreed that the iPad is a tool for classroom differentiation and that they were confident in using the apps for differentiation purposes. Differentiation in the classroom has garnered much attention in the recent years and educators are almost always asked to differentiate their instructions and teaching to meet the needs of students of different learning abilities. As such, the iPad was introduced to educators of this trial as a tool for differentiation where students can demonstrate their learning through different media (text, images, video, audio) and have a strong workflow to receive students' works and send feedback.

One trend that has been observed in the

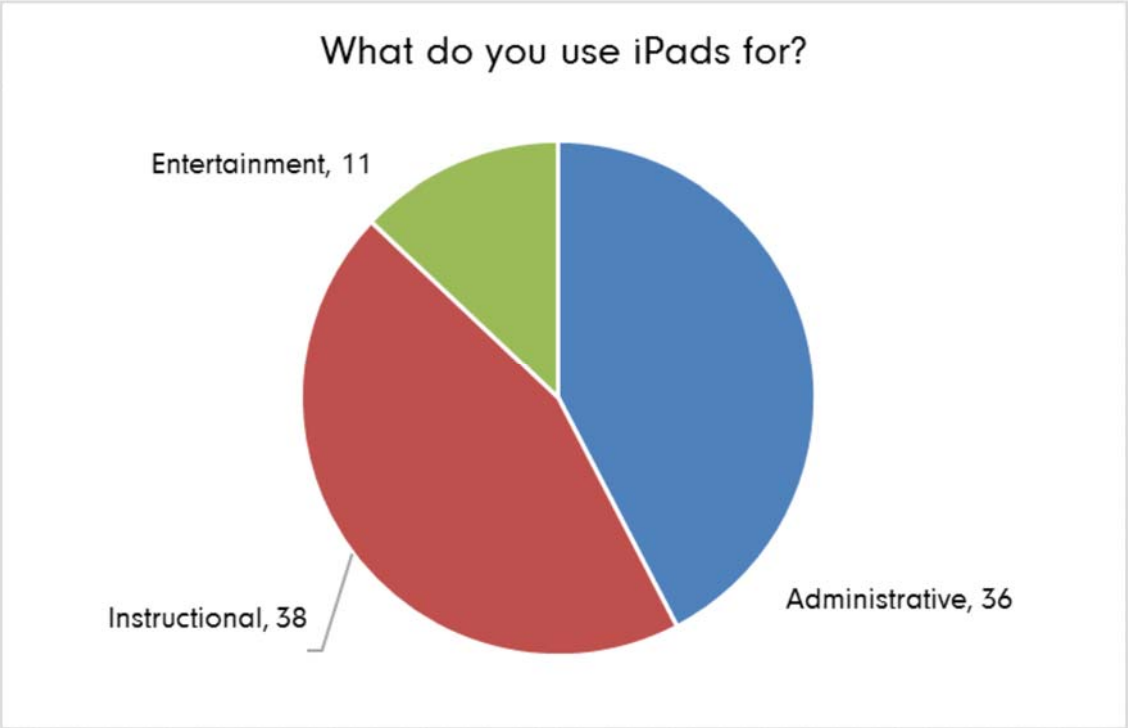

Figure 2: Response from survey questions (phase 1)

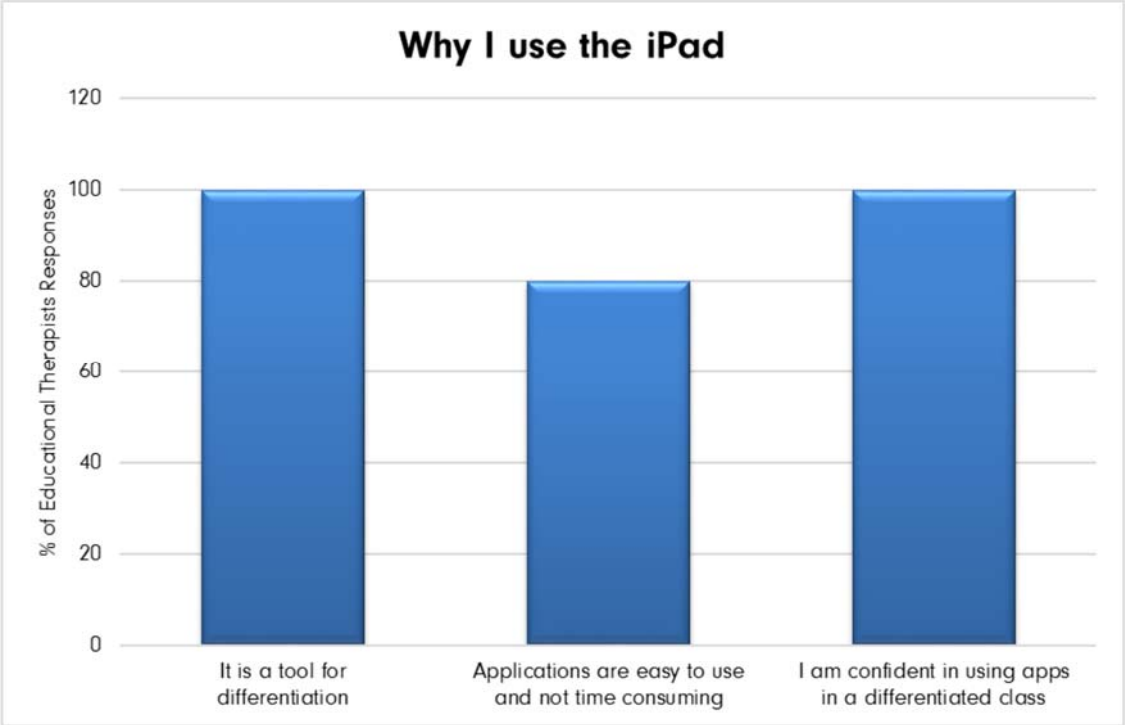

Figure 3: Teachers views on use of iPads

past 5 years is an increase in low-level disruptive behaviour in the classroom (Hatch, 2011). All teachers who participated in the ITI trial informed the investigators that they experienced such challenging behaviour in their classrooms. Yet, 15% of the educators who participated in the trial felt they had a better control of the class and their students' response and behaviour when they introduced the iPads into the classroom. Whilst pinpointing a cause for this might not be so easy, some possible reasons were suggested by the teachers themselves upon reflecting on the change.

Notably, some teachers felt that pupils who sometimes display disruptive behaviour often do so when they have run out of activity, or may be awaiting their turn for support from the teacher. It would seem that pupils with the iPad can immediately focus their attention on their iPad and use it to either find the answer to their question, or use any the other facilities until the teacher becomes available, minimising the opportunity for children to become disengaged. Not surprisingly, more obvious modification of behaviour was observed when the teacher provided clear instructions on using the tool to facilitate independent learning, anticipating the needs of the students prior to commencement of the lesson. As shown in Figure 4, more than half of the educators also observed that the students were more motivated, learnt concepts faster and agreed that using the iPads in the classroom was multisensorial.

Phase Two of ITI

With an achieved receptivity, the trial moved to the second phase. This explorative phase sought to determine if by experiencing the benefits of iPad in phase one, a phase where some of what was recommended by Ertmer and Ottenbreit-Leftwich (2010) was effectuated, educators would be more effective in

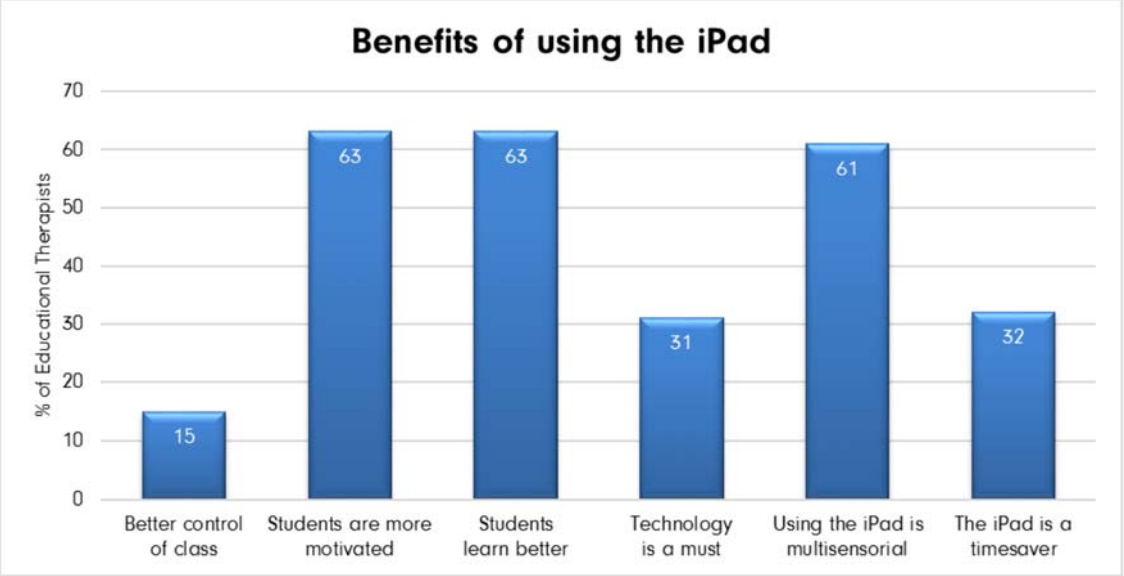

Figure 4: Teachers' feedback on benefits of iPad usage

implementing the use of technology in their classrooms. This time, thirty-six educators (as two of them dropped out of the study owing to a move to non-teaching roles), and seventy-seven students (as some students had either graduated or withdrawn) from phase one continued into phase two of the study. The devices used were the same as those in phase one, albeit with updated applications.

The setting for teacher-student interaction in classrooms was also the same, with about four students in a class on average and with interaction time of one or two hours per class. Similar to phase one but with one variation, students were included as respondents and both teachers and students were asked to provide feedback on their experiences with iPads as an everyday tool in the classroom. Feedback was obtained through Socrative and a personality quiz for educators was also conducted on Opinion Poll titled, *"What Type of iPad User Are You?"*

Emotional attachment (EA) is defined as a commitment to, or willingness to make a sacrifice for a product (MacInnis and Park, 1991). The importance of EA on an existing product was also demonstrated and highlighted in the case of the 'New Coke' (Ross, 2005; Schindler, 1992). EA towards new technology that teachers are required to embrace is important to ensure the sustenance of continued use of the technology and not be a short-term "in thing" (Vincent, 2009). The investment in iPads in DAS are meant to reconfigure the various aspects of the educators' everyday activities such that the iPads become a necessary and unavoidable part of their work. Adoption, pervasiveness and ubiquity of iPads amongst DAS educators is not a mere quantitative issue and thus, the development of emotional attachment to the device is an important foundation for the future development and growth of educational technology in DAS, which will be built on relativity to the iPads.

As ITI is still exploring the adoption of the new technology (IPad) by the teachers in DAS, EA might also be influenced by some degree of technology readiness (TR). Parasuraman (2000) defines TR as the likelihood to embrace technology and use it to achieve the goals at home or at work and literature exists that suggests that TR is a state of mind that would influence all aspects of the adoption process in the Technology Acceptance Model (TAM) (Lin, Shih and Sher, 2007; Lin and Hsieh, 2006). However, the impact of TR was not expected to make significant impact as the results of Phase One indicate strong potential of technology acceptance and readiness.

Phase two results

Using Socrative, which itself is an administrative and learning-assessing tool with real time results and reports, the educators were asked to provide feedback on phase two. As shown in Figure 5, when asked about the frequency of the incorporation of student-led apps into the classroom instruction, it was encouraging to note that none of the participants indicated "never" as an answer. All of the participants had continued to use the iPads and the apps at least once or twice each week, with the majority using it daily.

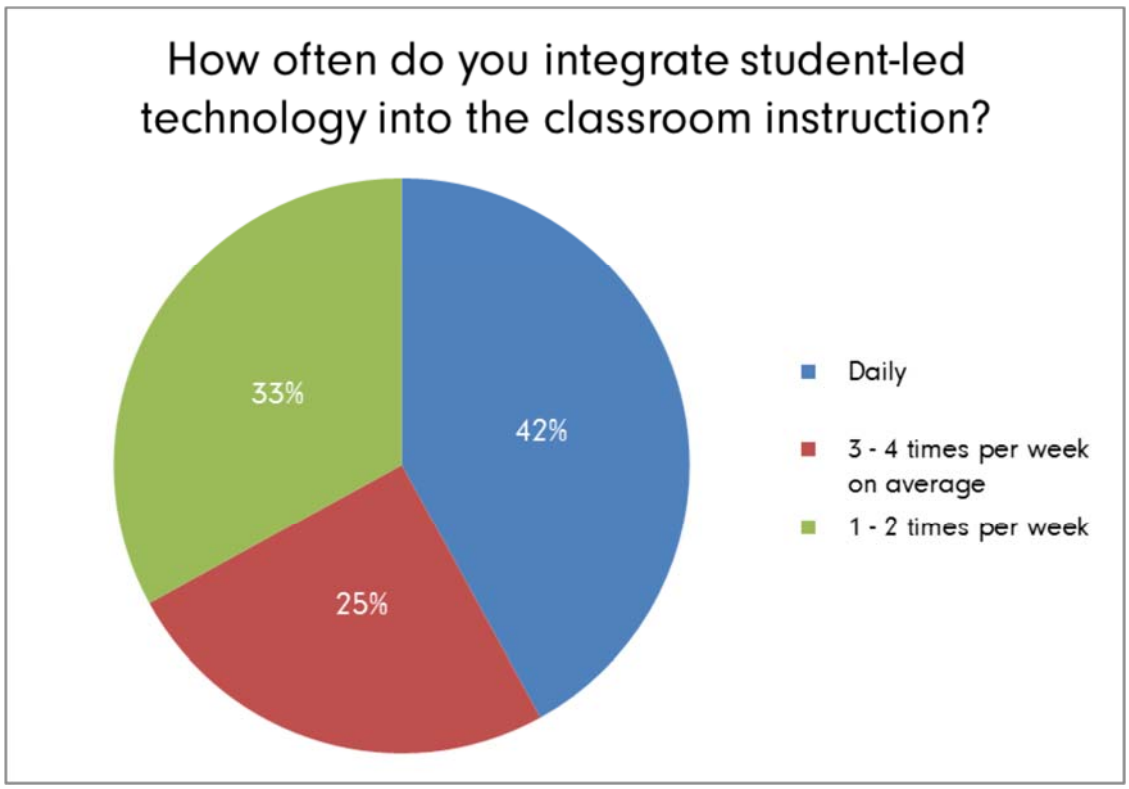

Figure 5: Frequency of use (Phase 2)

With reference to Figure 6, while the majority did not encounter barriers when using educational technology (iPad) in the classrooms, there were nonetheless problems faced. The first was insufficient number of iPads. Each educator had about two to three iPads and one of it is the assigned iPad for the teacher while the remaining sets were for student-use. Typically, the DAS classrooms have about three to four students in a class and to cater to the number, educators would either get the students to share the devices or, borrow iPads from other educators to cater to the needs of the class. This brings to mind the importance of resource utilisation and management and points to a need to further train teachers to utilise the available resources in a meaningful way during teaching and learning activities. Faulty devices and inadequate training were the other identified barriers and while DAS has an IT department, the speed at which issues are resolved needs to be further evaluated. It was noted that in-depth and specialised training sessions would better suit educators who are new to the iPads as compared to mass training sessions which cover broader information. Also, allowing educators the option to request for training or an avenue for clarification (through the EdTech's site) could alleviate the perception of inadequate training.

When asked about their level of confidence to create, edit, save and retrieve administrative documents over the iPad, slightly less than half of the educators indicated average confidence

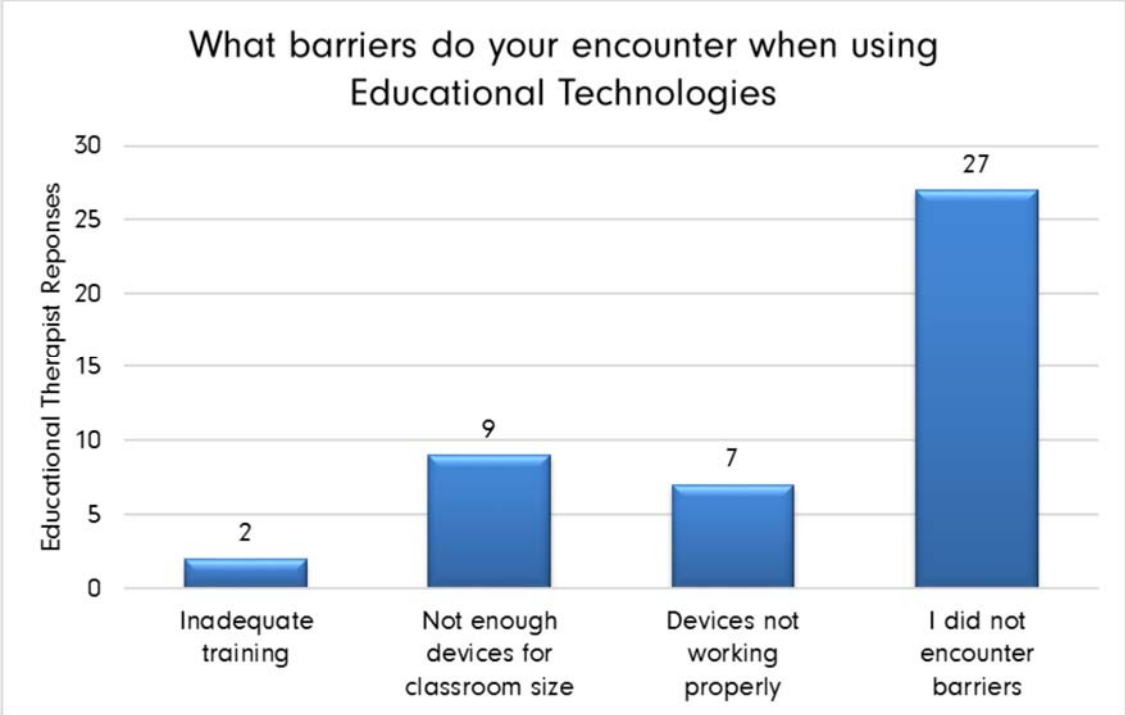

Figure 6: Challenges faced upon use (Phase 2)

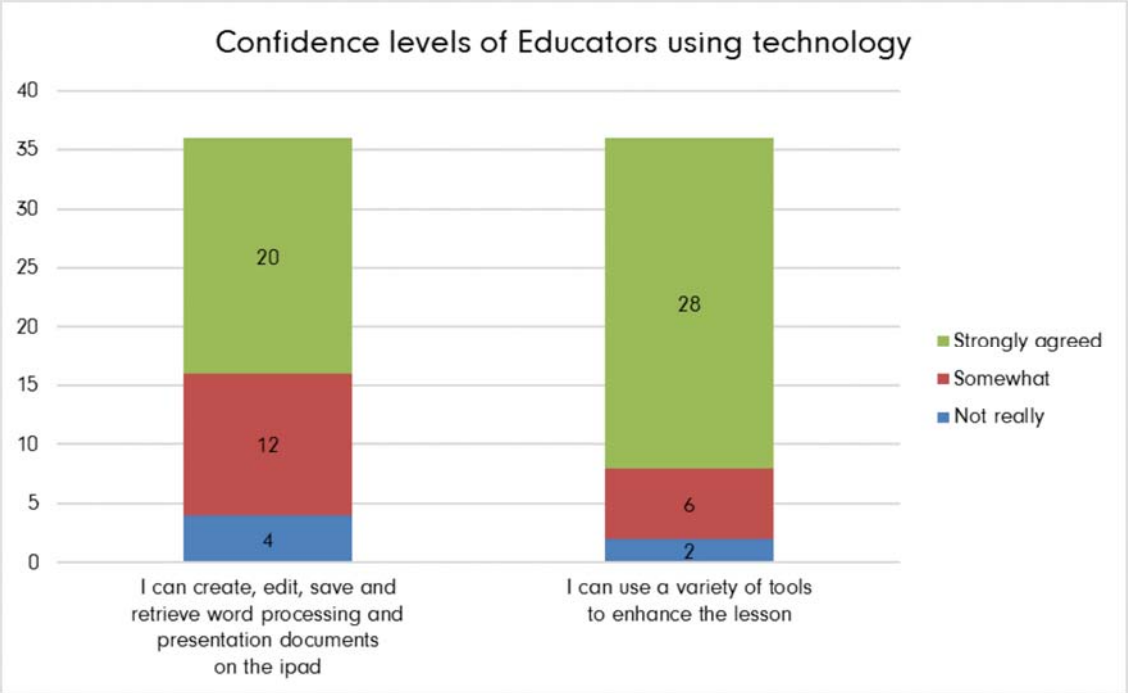

Figure 7: Confidence levels of educators (Phase 2)

levels. This could be because most of the word-processing documents are processed over the educators' laptops instead of the iPad. As such, though they have a good understanding on the processes to create, edit, save and retrieve documents, they may not have ample experiences in carrying out these processes specifically on the iPads. Currently, not all Learning Centres are equipped with air-print functions and this could have further deincentivised the chances of carrying out such functions on the iPad. On the whole, more than 75% of the educators were confident in using a variety of iPad tools to enhance the lesson, such as multiple apps, text-to-speech, camera, voice recording and etc.

As for the eighty-seven students who come from a range of age groups, questionnaires were also sent to them on the following questions :

1. What level are you studying in?
2. How often do you use the iPads in DAS?
3. Do you think you learn better when using the iPads?
4. What do you use the iPads the most for?
5. By using the iPads, d you feel that you are more attentive?
6. What other technology would you like to see in DAS classrooms?
7. On a range of 1-5, indicate how much you like using the iPads in DAS
8. I want to see more use of iPads in DAS classrooms.

As shown in Figure 8, students generally perceived that the iPad devices had helped them recognize words when reading and thus they were able to learn better in terms of fluency and comprehension. The age group that felt this benefit the most is the upper primary students who were about ten to twelve years of age. This corresponds with findings that remedial and tutorial use of technology can be particularly effective for lower attaining pupils (Lou et al., 2001) and those with special educational needs (Li & Ma, 2010; Sandy-Hanson 2006; Sisson, 2008) in providing intensive support to enable them to catch up with their curriculum in mainstream schools.

The general feedback from the students' ability to read and learn better also matches to the educators' frequency of iPad use as an educational tool in the classroom, where all educators in the trial ensured that the iPads and the apps were utilised at least once or twice every week, with the majority using it daily (see Figure 5). A higher frequency of use of technology can potentially lead to improvements in the students' abilities of reading and learning (McClanahan 2012).

Technology can be used very effectively as a short but focused intervention to improve learning (Bayraktar 2001; Moran et al., 2008), particularly when there is regular and frequent use (about three times a week: Cheung & Slavin; 2011) over the course of about a term of 5 -10 weeks (LeJeune, 2002; Sandy-Hanson, 2006). However, it's less conclusive if prolonged usage has similar benefits. According to some, sustained use over a much longer period is usually less effective at improving attainment (e.g. Liao 1992; Sandy-Hanson, 2006). The inconsistency in the evidence about more precise duration, intensity and type of

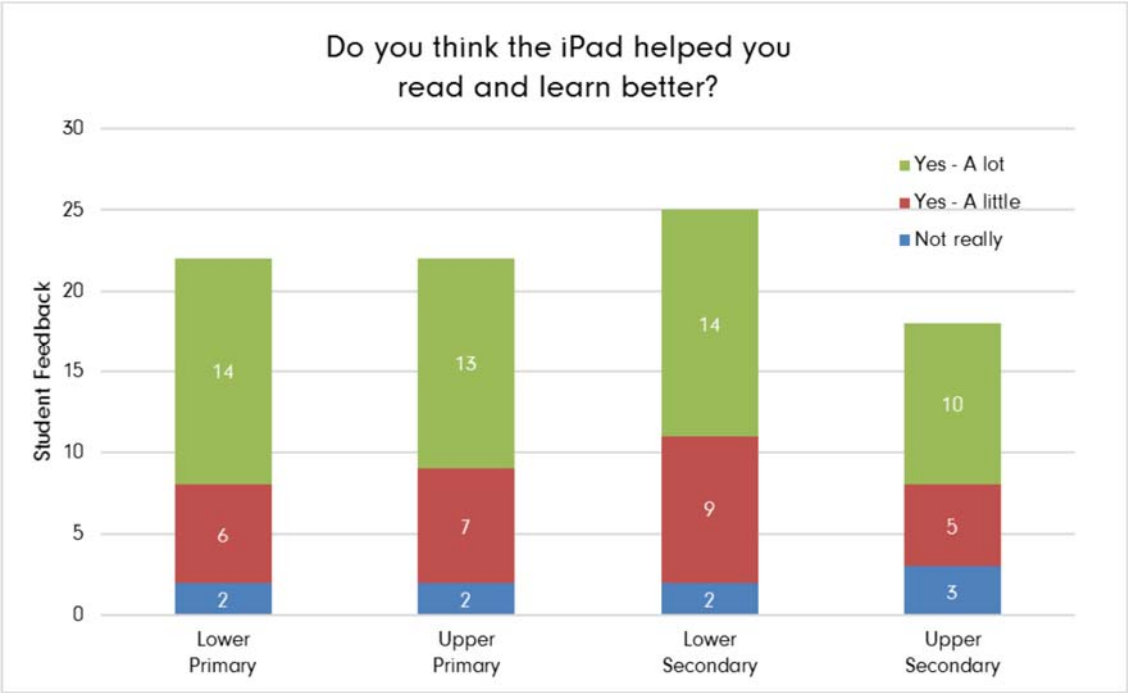

Table 8: Students' feedback on iPads helping them to read and learn better (Phase 2)

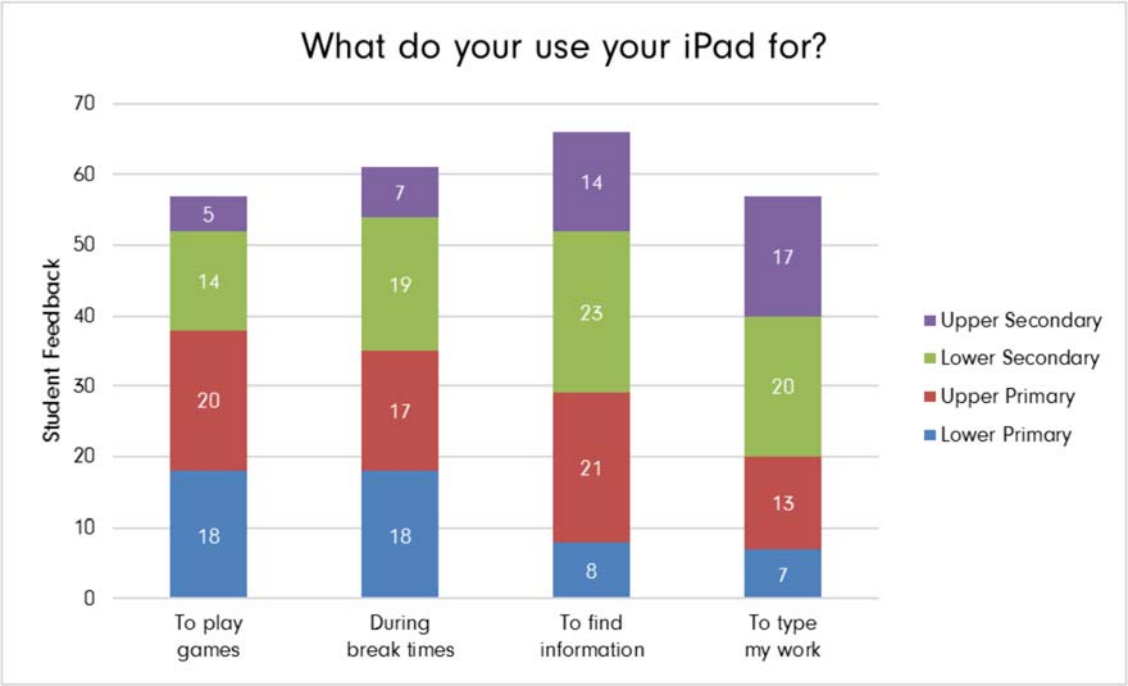

Table 9: Students' feedback on what they used the iPads the most for (Phase 2)

apps / functions used makes it difficult to draw firm conclusions. Nevertheless, a link may therefore be established between the perceived impression that the students were learning words better with iPads and the frequency of use of iPads in the classroom.

Further, when asked what the iPads were used for, students from each group responded and a trend was identified. As the age of the student users got older, the use for iPads moved away from "fun" and leaned towards using iPads for research purposes and also for typing their work. Students from the Primary School levels seemed to utilise the iPads more for the "fun" aspects such as playing games (which includes phonics and spelling apps) and also as a filler for break times, in between lesson components as shown in Figure 9.

Recommendations

Implementing new technologies can be exciting for both teachers and students. It is vital that the incorporation of technology is done in such a way to ensure that it adds to the overall education experience rather than inadvertently drawing from it. iPads have been found to be a favourite and also increase engagement (attention span) of students not just in DAS but in general (Cumming and Draper, 2013). There are a few pointers that teachers will need to take into account when planning to use the iPads in their classrooms, such as using rubrics to self-evaluate the effectiveness.

The ITI study concurs with existing studies that successful implementation relies heavily on the change agents such as teachers and school administration, who then activate the appropriate resources such as time in redesigning teaching and learning tasks and a reliable and efficient IT infrastructure in order to reap the full benefits that technology offers. From this study, it can be noted that the iPads are deemed as an appropriate administrative tool and also that educators were successfully reframed to be more effective in implementing the use of technology in their classrooms. Educators could independently incorporate technology effectively to better help dyslexic learners. Educators largely indicated that they did not face barriers in using technology and that there were very confident of creating and working with word processing documents on the iPads and also in using various iPad tools for their classrooms as well as administrative purposes. Students also reciprocated the approach with perceived feelings of increased confidence in reading and learning as along with having fun.

The challenge is to ensure that iPads are used to enable, enhance, and or make more efficient, effective teaching and learning practices and with clear objectives. Although the iPad's provision of opportunity for collaborative work is generally more effective in groups than individual use, some students, especially the younger ones, may need extra guidance on how to collaborate effectively and responsibly (Harrison et al., 2004). Technology can be a powerful and effective tool in short and focused interventions to improve learning, especially with regular and sustained duration of use. Ultimately, technology is best used to compliment teaching rather

than as a replacement of such teaching. Thus, educators must practice some caution over the way in which technology is embedded in the classroom.

Finally, the training for educators provided thus far tends to focus on iPad skills, apps, and the basics of using the device. This may just be one side of the coin to support educators, and thus the pupils, in getting the best from technology. Thus the EdTech Team will continue to provide on-going professional development and support to educators and conduct evaluations periodically to assess the impact on learning by collection of data on student behaviours, feedback on apps and also overall progress in learning through the curriculum-based-assessments, which are conducted bi-annually.

Future Initiatives and Studies

The MAP EdTech Team plans to go forward with the implementation of the Smartbar Technology, and conduct an explorative study which can be used to further enhance the lessons delivered with the assistance of iPads. The next study will examine the use of interactive Smart Bars as instructional tools to determine their impact on the literacy achievement of dyslexic learners in DAS. The research findings will be pivotal in determining the use of educational technology and its impact on teaching in MAP, measured through student achievement in classroom learning by comparing one group of students who will be learning with technology as required by the organisation, with another group of dyslexic students, who will be exposed to higher and fuller usage of technology.

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